

Fig. 1

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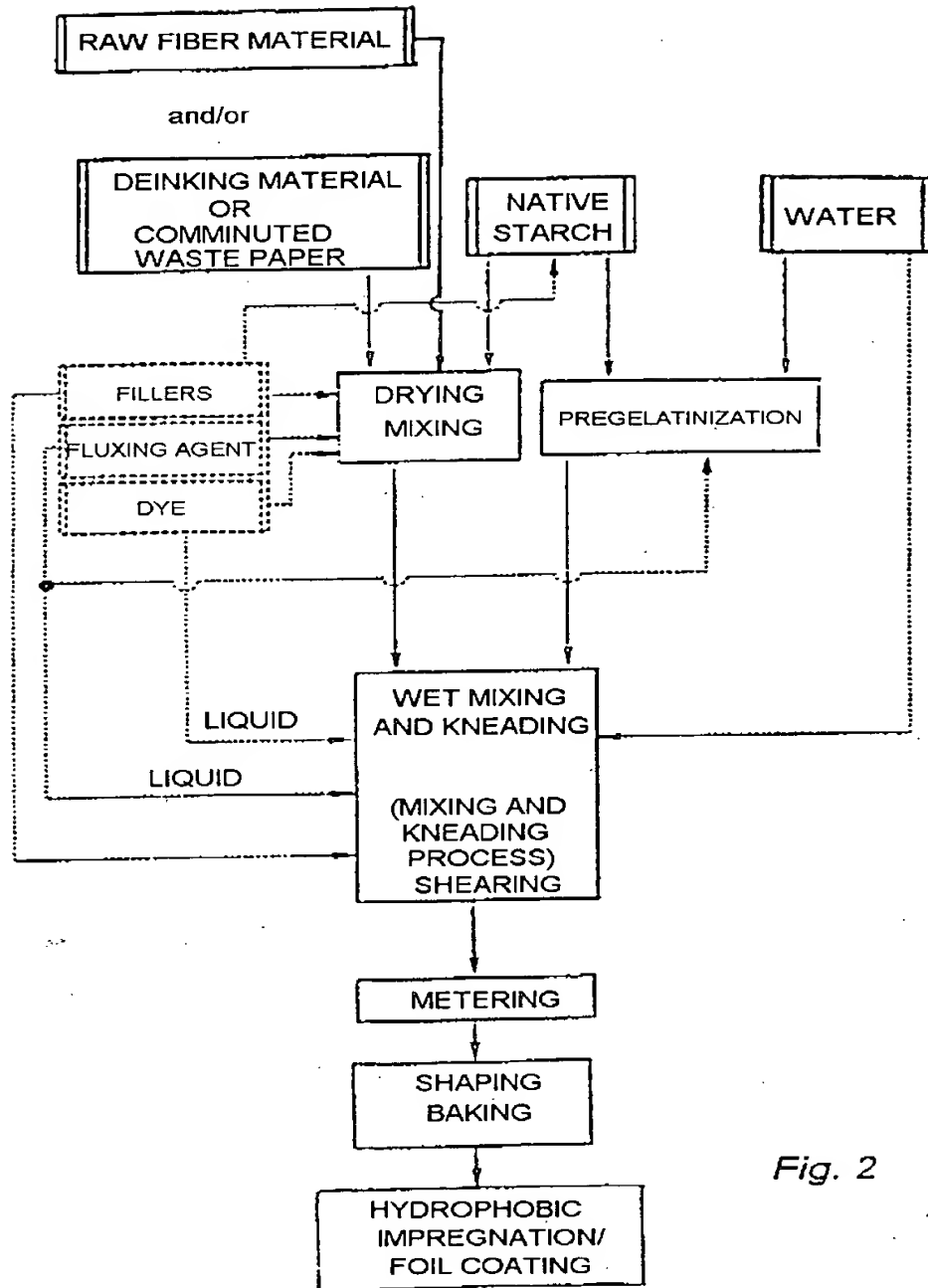


Fig. 2

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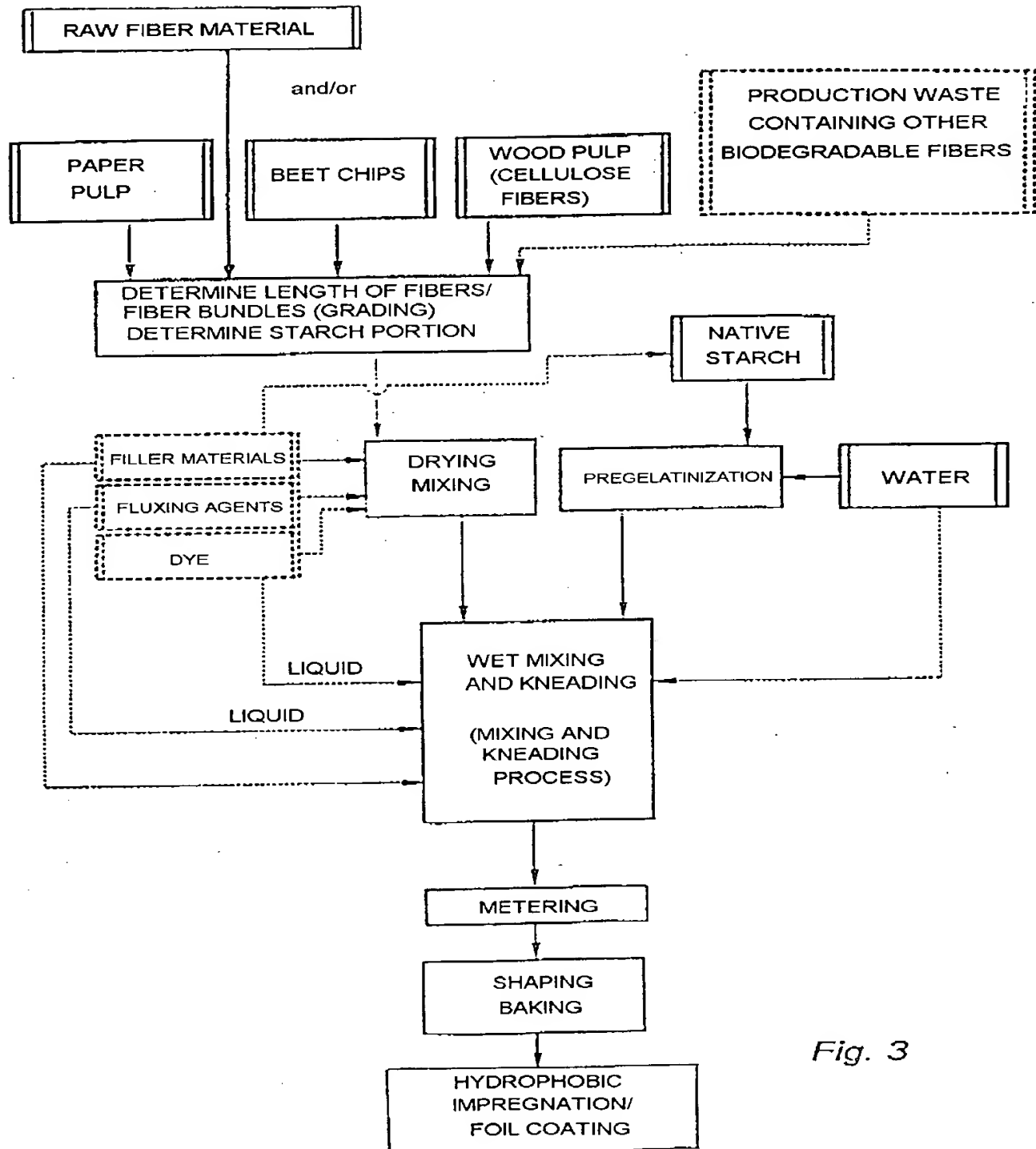


Fig. 3

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	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅
a	18,7	28,2	37,3	47	56,4	65,8	75	84,3	93,3	102,9	112,3	122	131,4	140,8	150

X₁-15 test sample

a in wt. % native starch

b = 250 wt. % water (in relation to dry mass of fiber material)

c = 100 wt. % fiber material

Fig. 4a

native starch

Problemuster	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	y12	y13	y14	y15
	25	84	113	131	150	169	188	206	225	244	263	281	300	150	75

- a = native starch in percent by weight
- b = 500 wt. % water in relation to fiber material (dry substance)
- c = 100% fiber material

Fig. 4b

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	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅
a	18,7	28,2	37,3	47	56,4	65,8	75	84,3	93,3	102,9	112,3	122	131,4	140,8	150
d	6,3	9,4	12,7	15,7	18,8	21,9	25	28,3	31,3	34,9	37,7	40,7	43,8	46,9	50
e	24,9	37,8	50	62,7	75,2	87,7	100	112,7	124,7	137,8	150	162,7	175,2	187,7	200

Fig. 5a

X₁-15 test sample

a in wt. % native starch

d in wt. % pregelatinized starch

e in wt. % total starch

b = 250 wt. % water (in relation to dry mass of fiber material)

c = 100 wt. % fiber material

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ratios

test sample	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	y12	y13	y14	y15
a	25	94	113	131	150	169	188	206	225	244	263	281	300	319	338
b	75	31	38	44	50	58	63	68	75	81	88	94	100	106	113
c	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400

a = native starch in wt. %

d = pregelatinized starch in wt. %

e = total starch in wt. %

b = 500 wt. % water in relation to fiber material (dry substance)

c = 100% fiber material

Fig. 5b

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Grade	Long fibers/ fiber bundles [mm]
1	0.96 - 1.44
2	1.92 - 2.40
3	2.40 - 2.88
4	0.72 - 2.16
5	3.06 - 3.57
6	2.55 - 4.59
7	0.24 - 1.68
8	0.24 - 4.32

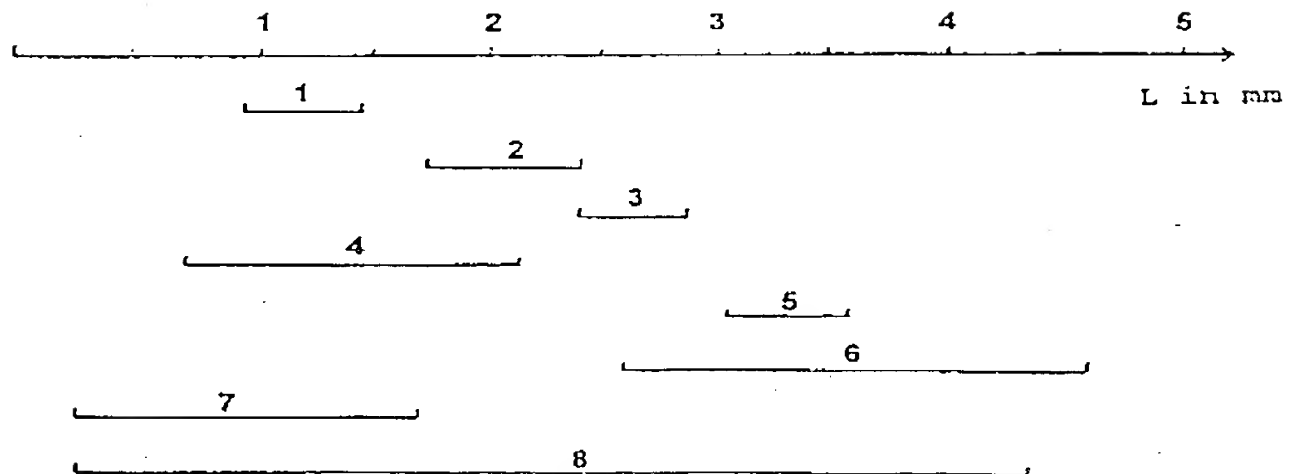
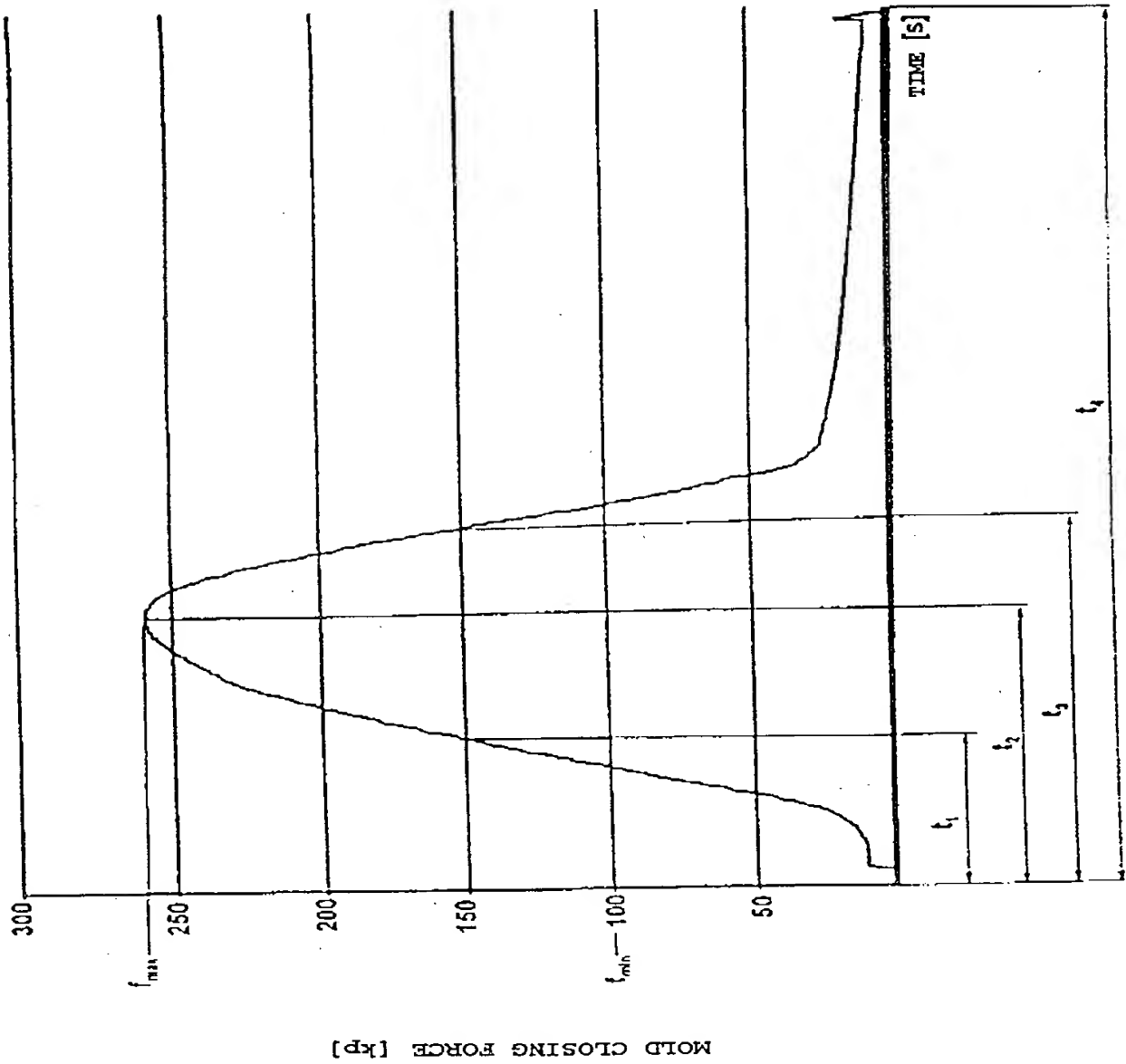


Fig. 6

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Fig. 7



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Use of fibers (fiber bundles) graded by fiber length according to Fig. 6

mold depth	~ 30 mm								~ 50 mm							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
fiber length	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
surface/ texture	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
strength/ stability	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
elasticity/ structure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

mold depth	~ 80 mm								> 80 mm							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
fiber length	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
surface/ texture	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
strength/ stability	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
elasticity/ structure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

+ molded body according to requirements

- molded body not according to requirements

Fig. 8

Use of fiber mixtures of different fiber length according to Fig. 6

mold depth	- 30 mm	- 50 mm	- 80 mm	> 80 mm
combination of fiber lengths according to Fig. 6	7 + 4 4 + 2	7 + 2 + 3 4 + 2 + 3	8 7 + 2 + 3 + 5	8 7 + 2 + 6 8 + 6
surface/ texture	- +	- +	+ -	+ - +
strength/ stability	+ +	+ +	+ +	+ + +
elasticity/ structure	- +	+ +	+ +	+ + +
fiber material/starch	60 : 40	55 : 45	50 : 50	45 : 55
starch/water	0,4 : 1	0,4 : 1	0,4 : 1	0,3 : 1

+ molded body according to requirements
 - molded body not according to requirements

Fig. 9

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in wt. %	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅
fiber material to total mass	26,7	25,8	25	24,2	23,5	22,8	22,2	21,6	21,1	20,5	20	19,5	19	18,6	18,2
total starch to total mass	6,6	9,7	12,5	15,2	17,7	20,1	22,2	24,3	26,2	28,2	30	31,7	33,4	34,9	36,1
water to total mass	66,7	64,5	62,5	60,6	58,8	57,1	55,6	54,1	52,7	51,3	50	48,8	47,6	46,5	45,5
pregelatinized starch to total mass	1,6	2,4	3,2	3,8	4,4	5	5,5	6,1	6,6	7,1	7,5	7,9	8,4	8,7	9

X₁-15 test sample

Fig. 10

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Percent by weight in mass

in wt. %	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	y12	y13	y14	y15
fiber/mass	14.3	13.8	13.3	12.9	12.5	12.1	11.8	11.4	11.1	10.8	10.5	10.3	10.0	11.8	12.9
total starch/mass	14.3	17.2	20.0	22.6	25.0	27.3	29.4	31.4	33.3	35.1	36.8	38.5	40.0	28.4	22.6
pregel. starch/mass	10.7	4.3	5.0	5.0	5.3	6.8	7.4	7.9	8.3	8.8	9.2	9.6	10.0	11.8	12.9
water/mass	71.4	69.0	66.7	64.5	62.5	60.8	58.8	57.1	55.8	54.1	52.8	51.3	50.0	58.8	64.5

y1-15 = test sample

Fig. 11

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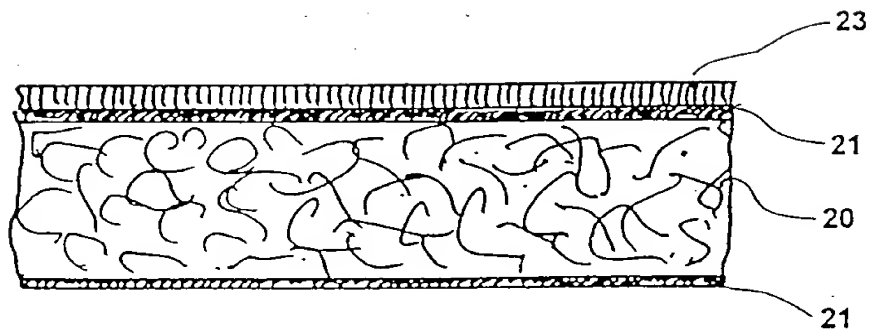


Fig. 12

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Trays dimensions 112 x 200 x 17.5 mm

Pots dimensions Ø 125 mm, vol. 500 ml, height 76 mm

Recipe: Y14

Coating: cellulose acetate (CA)

TS: 4.5% - 15 wt. % dry substance in spray solution

η : 20 - 4000 mPas (viscosity)

Application: spraying, casting, dipping

Layers: 1 - 3 (quantity)

Solvent: acetone

Shape	Thick- ness	Coating	Method	Resistance		
				water 100°C	oil	water
				1h	(cold) 3 days	(cold) 3 days
pot	89 μm	3.8 g	casting	+	+	+
tray	79 μm	2.3 g	casting	+	+	+
pot	65 μm	2.8 g	spraying	+	+	+
tray	68 μm	2.0 g	spraying	+	+	+
tray	58 μm	1.7 g	spraying	+	+	+
pot	34 μm	1.5 g	spraying	-	-	-
tray	27 μm	0.8 g	spraying	-	-	-

Fig. 13

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Trays dimensions 112 x 200 x 17.5 mm

Pots dimensions \varnothing 125 mm, vol. 500 ml, height 76 mm

Recipe: Y14

Coating: cellulose acetate propionate(CAP)

TS: 9% - 20 wt. % dry substance in spray solution

 η : 200 - 6000 mPas (viscosity)

Application: spraying, casting, dipping

Layers: 1 - 3 (quantity)

Solvent: acetone

Shape	Thickness	Method	Resistance		
			water 100°C 1h	oil cold 3 days	water cold 3 days
pot	88 μ m	casting	+	+	+
tray	88 μ m	casting	+	+	+
pot	58 μ m	spraying	+	+	+
tray	70 μ m	spraying	+	+	+
tray	56 μ m	spraying	+	+	+
pot	33 μ m	spraying	-	-	-
tray	22 μ m	spraying	-	-	-

Fig. 14

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Trays dimensions 112 x 200 x 17.5 mm

Pots dimensions Ø 125 mm, vol. 500 ml, height 76 mm

No.	Foil	Thick- ness	Deep- drawing quality in tray	Deep- drawing quality in tray	Resistance		
					water 100°C	oil cold	water cold
1	poly- ester amide	100 µm	+	-	-	+	+
		150 µm	+	-	—	+	+
2	poly- ester	70 µm	+	-	—	+	+
3	poly- lactic acid (rigid)	50 µm	-	-	-	+	+
		100 µm	-	-	-	+	+
4	poly- lactic acid (elast.)	50 µm	+	-	+	+	+
		100 µm	+	+	+	+	+

Foil	Melting point
1	approx. 120°C
2	approx. 85°C
3	approx. 115°C
4	approx. 130°C

Fig. 15

Cellulose acetate / Cellulose acetate propionate

Softener 10-30 wt. %					without softener
	Diethyl- phthalate	Triacetin	Tributyl citrate	Acetyl tributyl citrate	
CA	V+/H+	V+/H+	V-/H-	V-/H-	H O
CAP	V+/H+	V+/H+	V+/H+	V+/H+	H +

Key: + = good O = medium - = poor
 V = compatibility H = adhesion

Fig. 16

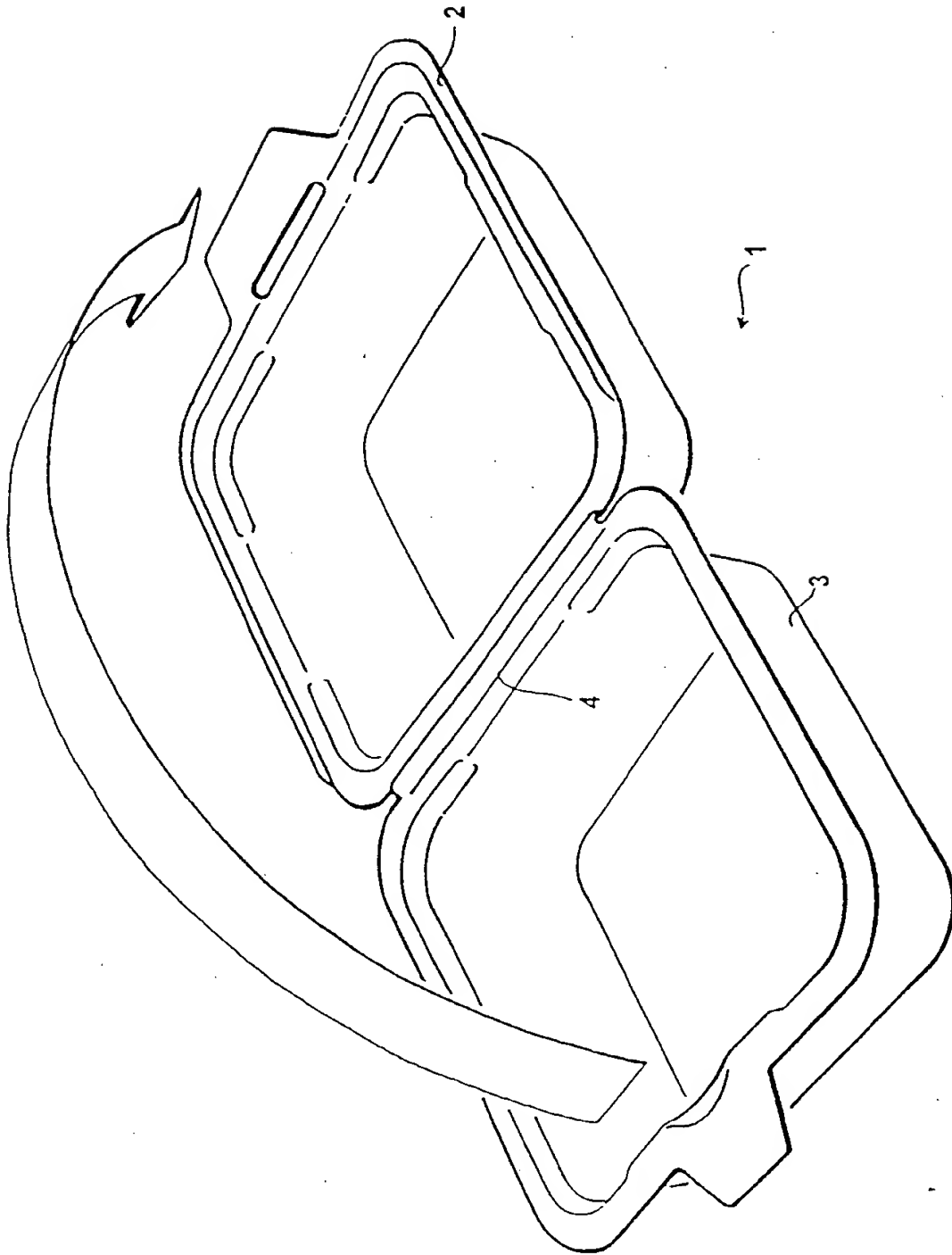


Fig. 17

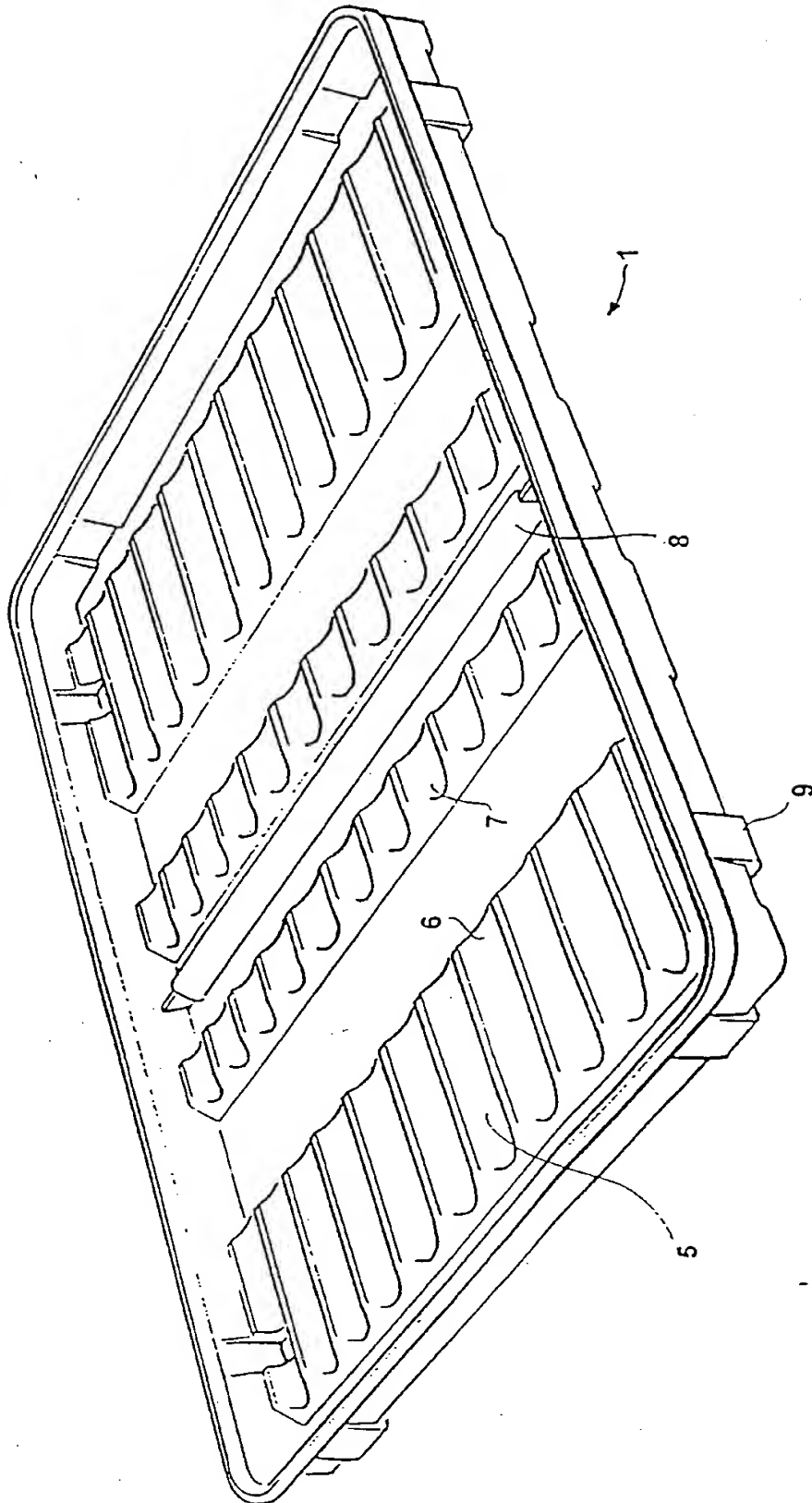


Fig. 18

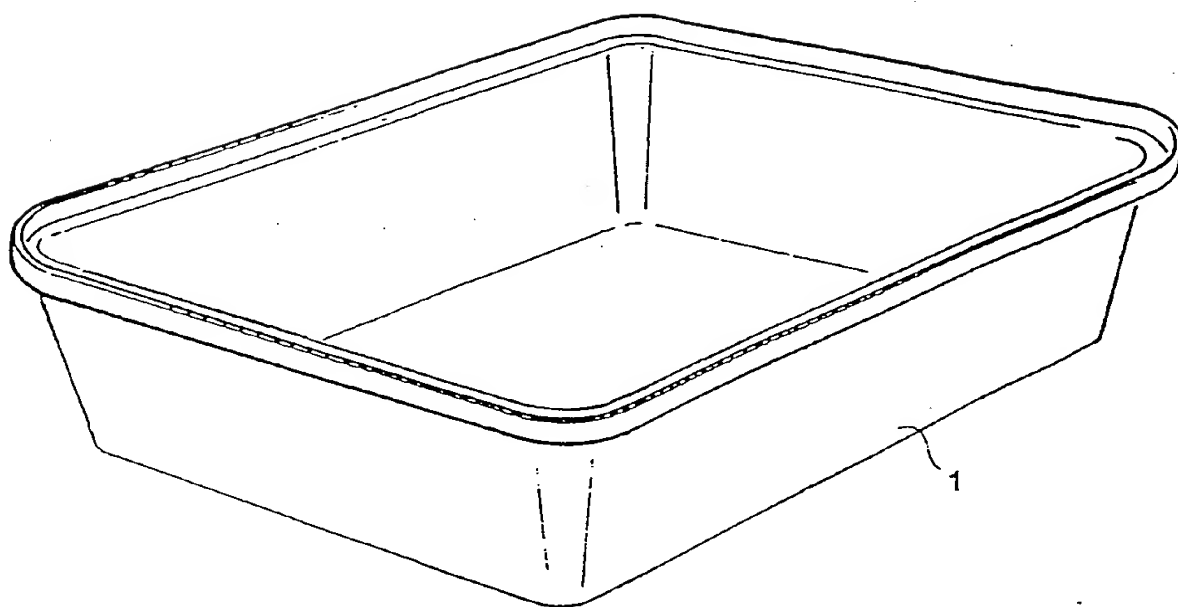


Fig. 19

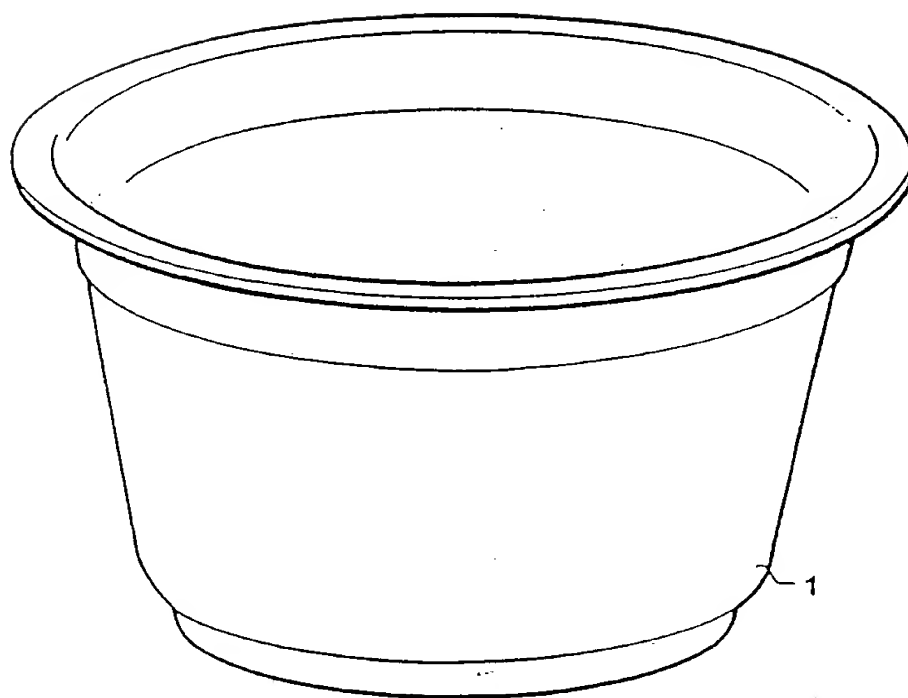


Fig. 20